PRELIMINARY SURVEY OF THE FLORA AND FAUNA OF THE TATA ISLANDS AND ADJACENT MAINLAND, GOLDEN BAY, NEW ZEALAND

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ABSTRACT

The fauna and flora of the Tata Islands (40° 49'S, 172° 55'E) were briefly examined and compared with plots on adjacent mainland areas. Dense broadleaf forest covers Motu I., but the original forest cover of Ngawhiti I. was burnt off for farming and now is covered with scrub and grassland. Farming has been discontinued on Ngawhiti I., and the grassland and scrub may be part of a succession back to broadleaf forest. The two broadleaf forest plots examined on the mainland had open understories attributable to grazing activity by introduced animals.

Rotting wood and litter samples were collected from both islands and the mainland areas, and the arthropod and molluscan faunas were compared.

Soil profiles of the islands are presented. Brachiopod and oyster fossils were abundant in limestone outcrops on the islands.

INTRODUCTION

In November 1967 an expedition of nine students and one staff member of the University of Canterbury spent six days surveying the flora and fauna of the Tata Is and adjacent mainland. The main purpose of the survey was to compile species lists so that, with respect to their flora and fauna, the islands could be compared with each other, and with the mainland.

GEOGRAPHY AND HISTORY OF THE ISLANDS

The Tata Islands, comprising Motu and Ngawhiti Is (Fig.1) (40° 49'S, 172° 55'E), are located about 0.75 km off Tata beach, c. 14.5 km north-east of Takaka in Golden Bay. The inland side of Ngawhiti I. is a registered anchorage shown on marine charts as the "Tata Islands Anchorage". The islands have been administered by the Abel Tasman National Park Board since 1954.

Ngawhiti I., the nearer to Tata Beach, is about 1.5 ha in area and Motu I. is about 2.0 ha. At the longest axes Ngawhiti I. is about 220 m and Motu I. about 320 m. Both average 70 m in width. Plateaux of both islands lie between 18 and 30 m above sea level.

Limestone cliffs, very steep to sheer and 18 to 27 m high, surround both islands. Landing beaches at the southern end of both islands provide easiest access to the plateaux. The rocks

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at the cliff bases along the southern and eastern shores of both islands are richly fossiliferous and scattered fossil beds are exposed throughout the islands. In all instances the dominant fossils are those of brachiopods and oysters.

There is a marked vegetational difference between the islands. Ngawhiti I. has been cleared but Motu I. remains covered in native bush. At present, Ngawhiti I. has an area of introduced grass, bracken fern (*Pteridium aquilinum esculentum* (Forster f.) Kuhn), flax (*Phormium cookianum* Le Jolis) and shrubs (*Coprosma robusta* Raoul; *Hebe salicifolia* (Forster f.) Pennell). In contrast, Motu I. is bush covered, containing as a main canopy whiteywood (*Melicytus ramiflorus* J.R. et G. Forster), mapou (*Myrsine australis* (Richard) Allan), and pigeonwood (*Hedycarya arborea* J.R. et G. Forster). The floor is fern covered (*Asplenium lucidum* Forster f.; *Blechnum* spp.) with tangles of supplejack (*Rhipogonum scandens* J.R. et G. Forster) and many tree seedlings.

Invertebrates are abundant on both islands but the only vertebrates seen were birds.

Both islands have well drained soils and differ only slightly from one another in their highly developed profiles. On Motu I. plateau, limestone rocks jut up to 3.6 m above the soil surface. There are no springs or streams on the islands.

Historical effects which have influenced the fauna and flora of Ngawhiti I. include the following:

1. About 1908 the south-eastern corner of Ngawhiti I. was mined for limestone by a Nelson limeworks. A hut was built during this operation and today remains as a shell.
2. About 1910 a small number of rabbits were released on the island but were exterminated a year or two later.
3. In the 1930s an elderly fisherman lived on the island.
4. In the early 1950s fire swept across Ngawhiti I.
5. A small number of sheep belonging to a local farmer were kept on the island for a few years after the above mentioned fire. Several good crops of grass seed were harvested during this period.

A headstone was erected on Ngawhiti I. as a memorial to an ex-soldier who had his ashes spread on the island in the 1950s. This served as a reference point on Ngawhiti I.

Tourists and holidaymakers frequently visit Ngawhiti I. In contrast, Motu I. appears to be untouched by man, probably because it is less accessible.

CLIMATE

The area has a cool, subhumid climate. Mean annual temperature is about 12°C and the region receives about 1100 - 1500 mm rain per annum. Bright sunshine averages just over 2000 hours and the frost season lasts 100 to 150 days (McLintock 1960).

GEOLOGY

Tata Is consist of crystalline limestone of Oligocene age, and are the only limestone areas in Abel Tasman National Park. Eroded limestone provides shelter for nesting and moulting penguins. The adjacent mainland consists of granite.

RESULTS OF THE SURVEY

SOILS

Soils are generally yellow-brown podsols. Descriptions of soil samples are presented in Table 1. Well developed profiles are topped by a thick layer of decaying litter, which probably inhibits evaporation and accounts for the luxuriant vegetation in the absence of running water.

TABLE 1. DESCRIPTIONS OF THE SOILS OF THE TATA ISLANDS

Ngawhiti I.:

Profile taken under gently sloping grassland (Fig. 1).

Aoo & Ao	38 mm	decaying vegetation and litter.
A_1	200 mm	black (5YR 2/1) sandy loam; very friable with moderately developed crumb structure. Many, often matted, plant roots.
A_3B_1 transition	250 mm	of mainly B horizon with frequent inclusions of either A horizon or charcoal.
B_2	250 mm and over	of yellow-brown (10YR 5/6) sandy silt loam, friable with weakly developed nut structure.

Motu I.:

Profile taken under broadleaf forest on a flat floor covered with *Asplenium lucidum* (Fig. 1).

Aoo & Ao	25 mm	litter and decaying vegetation.
A_1	270 mm	very dark grey (10YR 3/1) sandy loam, friable, with moderately developed nut structure. Thick tree roots prevalent. Some decayed limestone stones present.
A_3B_1 transition	250 mm	of mainly B horizon with patches of A in worm burrows.
B_2	100 mm	yellow-brown (10YR 5/8) clay loam with patches of limestone base. Weakly developed blocky structure. This layer extended to a solid limestone base that could be C horizon or a large rock.

FAUNA

Mammals

Mousetraps set on Ngawhiti I. were found sprung on three different occasions with bait missing, but no animals were caught. A burrow under the derelict hut on Ngawhiti I. suggested that rats or mice could be present. On the adjacent mainland hedgehogs were common, but none appeared to have reached the islands.

Birds

Birds were the only vertebrates seen on the islands. Several fantails (*Rhipidura fuliginosa fuliginosa*), tomtits (*Petroica macrocephala macrocephala*), and blackbirds (*Turdus merula merula*) were seen, and the nest of a song thrush (*Turdus philomelos*) was found.

TABLE 2. BIRDS OF THE TATA IS AND MAINLAND REGION. Nomenclature follows the O.S.N.Z. (1970) checklist, and species are arranged according to Falla et al. (1966). * = introduced species. M = Motu I, N = Ngawhiti I, P = Pohara, T = Totaranui, TB = Tata Beach.

Eudyptula minor (Forster, 1781) ssp. (Cook Strait blue penguin) M, P, T, TB
Macronectes giganteus (Gmelin, 1789) (giant petrel) TB
Sula bassana serrator Gray, 1843 (Australian gannet) T, TB
Phalacrocorax melanoleucos brevirostris Gould, 1837 (little shag or white throated shag) TB
Ardea novaehollandiae (Latham, 1790) (white-faced heron) P, TB
Circus approximans gouldi Bonaparte, 1850 (Australasian harrier) TB
**Lophortyx californica brunnescens* Ridgway, 1884 (Californian quail) P, T
Porphyrio porphyrio melanotus Temminck, 1820 (pukeko) TB
Haematopus ostralegus finschi Martens, 1897 (South Island pied oystercatcher) P
Haematopus unicolor Forster, 1844 (black oystercatcher) M
Larus dominicanus Lichtenstein, 1823 (southern black-backed gull) M, N, T, TB
Larus novaehollandiae scopulinus Forster, 1844 (red-billed gull) TB
Chlidonias hybrida albostriatus (Gray, 1845) (black fronted tern) T, TB
Hydroprogne caspia (Pallas, 1770) (Caspian tern) T
Sterna striata (Gmelin, 1789) (white fronted tern) T, TB
Hemiphaga novaeseelandiae novaeseelandiae (Gmelin, 1789) (New Zealand pigeon) M
Ninox novaeseelandiae novaeseelandiae (Gmelin, 1788) (morepork) TB
Halcyon sancta vagans (Lesson, 1830) (kingfisher) TB
**Alauda arvensis arvensis* Linnaeus, 1758 (skylark) TB
Rhipidura fuliginosa fuliginosa (Sparrman, 1787) (fantail) M
Petroica macrocephala macrocephala (Gmelin, 1789) (tomtit) M
Mohoua ochrocephala (Gmelin, 1789) (yellowhead) TB
**Turdus philomelos* Brehm, 1831 (song thrush) M, P, TB
**Turdus merula merula* Linnaeus, 1758 (blackbird) M, P, T, TB
**Passer domesticus domesticus* (Linnaeus, 1758) (house sparrow) P, TB
Anthornis melanura melanura (Sparrman, 1786) (bellbird) M, TB
Prosthemadera novaeseelandiae novaeseelandiae (Gmelin, 1788) (tui) TB
**Fringilla coelebs gengleri* Kleinschmidt, 1909 (chaffinch) TB
**Sturnus vulgaris vulgaris* Linnaeus, 1758 (starling) P, TB

On Motu I. a bellbird (*Anthornis melanura melanura*) was heard and several native pigeons (*Hemiphaga novaeseelandiae novaeseelandiae*) were seen. Several species of sea-birds were seen about both islands (Table 2).

Penguin trails and nesting sites were found on the southern ends of both islands, although no penguins were seen on land. A Cook Strait Blue penguin (*Eudyptula minor* ssp.) was seen swimming off Motu I. Several dead specimens of this species were found on the mainland beaches.

Invertebrates

i. Soil and litter fauna (Table 3)

Seventeen soil and litter samples were taken. Collections were made by placing a 0.3 x 0.3 m quadrat over the site chosen; the top 50 mm of litter and soil was then removed and placed in a plastic bag until sorted.

Invertebrates were hand sorted from the samples, and as a consequence small individuals were probably overlooked. Results are summarized in Table 3.

TABLE 3. INVERTEBRATE NUMBERS IN SOIL AND LITTER SAMPLES COLLECTED FROM THE ISLANDS AND MAINLAND

Key: Locality and description of sample sites A-Q

NGAWHITI I.
- A. Under bracken fern, no litter.
- B. Under grass and blackberry (*Rubus* sp.). No litter.

MOTU I.
- C. *Melicytus ramiflorus* and *Myrsine australis* canopy. Litter 40 mm.
- D. Thin *M. ramiflorus* canopy, *Rhipogonum scandens* to north. Litter 20 mm.
- E. *M. ramiflorus* and *M. australis* canopy. *Asplenium lucidum* floor cover, litter 25 mm.
- F. *M. ramiflorus* canopy, fern floor cover. Litter 25 mm.
- G. *M. ramiflorus* canopy, fern floor cover, north area. Litter 30 mm.
- H. *M. ramiflorus* canopy, fern floor cover, southeast area. Litter 25 mm.
- I. *M. ramiflorus* canopy, fern floor cover, southwest area. Litter 20 mm.

TOP PLOT
- J. Mixed canopy, litter 40 mm.
- K. Mixed canopy, litter 40 mm.
- L. Litter in a tree hole.
- M. Litter in a tree hole.

CHRISTOPHERS PLOT
- N. Mixed canopy, litter 25 mm, leafy and loamy.
- O. Mixed canopy, litter 25 mm, leafy and loamy.
- P. Mixed canopy, litter 12 mm, thin and leafy.
- Q. Mixed canopy, litter 12 mm, very thin.

	SAMPLE SITE															
INVERTEBRATE GROUPINGS	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Amphipoda	4	22	20	8	13	6	7	.	4	9	6	.	.	19	.	.	.
Isopoda	.	.	3	.	8	4	2	.	.	.	3	.	.	.	6	.	.
Pseudoscorpionidea	.	.	1	.	.	.	1	1	.	.	2	.	.	.	.	.	.
Other Arachnida	7	4	6	2	8	2	7	1	1	5	8	5	2	1	6	.	.
Diptera larvae & pupae	1	4	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Other Diptera	.	.	1	1	.	2	4	1	.	.	2	.	.	.	3	.	3
Lepidoptera and Coleoptera larvae	3	3	.	.	2	.	.	.	2	1	3	5	.	6	.	.	.
Other Lepidoptera	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Other Coleoptera	.	.	.	.	.	3	5	1	.	.	3	.	.	6	.	2	.
Formicidae	.	.	.	.	.	.	2	.	1	.	3	.	.	10	.	.	.
Other Hymenoptera	.	.	1	.	.	.	.	.	1	6	.	.	.	.	.	.	.
Hemiptera	.	.	.	.	.	1	.	.	1	3	2	.	.	9	.	.	.
Collembola	.	1	2	2	.	.	.	1	.	.	.	.	5	.	.	.	.
Dictyoptera	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Chilopoda	.	3	.	.	.	1	.	.	.	.	5	1	.	3	.	7	.
Diplopoda	.	.	.	.	.	2	1	.	.	4	2	.	.	8	6	2	4
Enchytraeidae	.	3	4	.	.	.	.	.	.	6	6	.	5	40	.	13	300
Oligochaeta	.	.	7	.	2	.	.	.	.	.	.	2	.	2	.	.	.
Mollusca	.	.	25	.	4	5	5	1	.	1	2	1	4	5	2	1	1

Samples from the islands contained a higher proportion of amphipods than those from the mainland. This could be partly due to the absence or low numbers of several mainland groups on the islands allowing amphipods to extend their habitat range. Isopods were not found on Ngawhiti I. but were present in all other areas. Arachnids were well represented in all samples, whereas Coleoptera numbers were generally low. Chilopods and diplopods were found in low numbers on the islands, in contrast to their high numbers on the mainland. More molluscs were found on Motu I. than on the mainland, but none was found on Ngawhiti I.

Ngawhiti I. appeared to have a higher proportion of winged insects than the other areas studied. This observation was confirmed by taking standard sweepnet samples (10 sweeps per sample). On Ngawhiti I. 20-30 winged insects/sample were obtained, whereas in other areas the number collected varied between 0 and 5.

ii. Rotting wood fauna (Table 4)

Seventeen pieces of rotting wood were examined for the presence of animals. Most pieces of wood were about 0.3 m long and 50-70 mm in diameter. The fauna was extracted from the wood by whittling.

Motu I. although bush covered, had less rotting wood than the mainland areas studies. Ngawhiti I. was almost devoid of rotting wood.

Samples from the mainland contained a greater number of specimens per sample than samples from the islands. Insect larvae made up a large proportion of rotting wood populations. As in soil and litter samples, chilopods and diplopods were rare on the islands but numerous on the mainland. Molluscs were not as common in rotting wood as they were in soil and litter. Ants were found in well rotted wood in all areas studied, whereas termites were only found on the mainland.

There appeared to be a succession of animals in rotting wood with different associations being formed at different stages of rotting (Table 4). In slightly rotten wood, insect larvae predominated. As rotting continued, a greater number of individuals and animal groups were found, including myriapods, arachnids, molluscs, and ants. Highest animal concentrations were found in medium-rotted wood.

FLORA

The area now occupied by Abel Tasman National Park was originally podocarp-broadleaf forest with associations of all New Zealand beech (*Nothofagus*) species (Esler 1962). Vegetation on Tata Is is not mentioned in early records, but was probably similar to the mainland.

Today, only remnants of the forest are present on land close to the islands (Fig. 1). This is the result of removing the forest to allow farming. Vegetation now mainly consists of bracken fern and gorse, with scattered patches of broadleaf scrub and manuka. Ngawhiti I. seems to have suffered the same fate as the adjacent mainland, and now is covered with bracken fern, gorse, blackberry, introduced and native grasses and herbs, and some karamu (*Coprosma robusta*). Motu I. is covered with native forest.

TABLE 4. INVERTEBRATE NUMBERS IN ROTTING WOOD SAMPLES COLLECTED FROM THE ISLANDS AND MAINLAND

Key: Locality and description of sample sites A-Q

NGAWHITI I.
A. Medium rotting wood.

MOTU I.
B. Medium rotting wood.
C. Slightly rotting wood, near a rock.
D. Well rotted wood, near centre of island.
E. Well rotted wood, near centre of island.
F. Very dry rotting wood.
G. Medium rotting wood.

TOP PLOT
H. Medium rotting wood.
I. Dry rotten wood.
J. Dry medium rotting wood.
K. Dry rotten wood.
L. Beginning to rot.

CHRISTOPHERS PLOT
M. Dry rotten wood, western aspect.
N. In a wood crevice.
O. Medium rotting wood.
P. Dry rotten wood.
Q. Dry rotting wood.

	SAMPLE SITE															
INVERTEBRATE GROUPINGS	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Diptera adults	.	.	.	.	.	.	.	13	1	.	.	.	.	.	.	.	.
Diptera larvae & pupae	.	1	.	.	4	.	.	2	1	2	7	1	8	.	.	.	6
Coleoptera adults	.	.	1	.	.	.	.	.	.	1	.	.	.	.	6	.	.
Coleoptera larvae	.	.	.	.	1	.	.	.	1	.	3	.	.	.	.	7	.
Lepidoptera larvae and pupae	.	.	1	.	.	.	.	.	1	.	8	4	4	.	6	2	.
Formicidae	10	.	.	col	.	.	.	3	.	4	.	.	.	11	.	.	.
Isoptera	.	.	.	.	.	.	.	.	.	.	.	.	60	.	.	.	.
Collembola	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Amphipoda	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6	.	.
Isopoda	.	.	.	.	3	.	1	.	.	2	.	.	.	.	9	.	.
Chilopoda	.	.	.	.	2	.	.	.	1	1	2	1	.	.	4	.	.
Diplopoda	.	.	.	.	.	.	1	.	2	.	.	.	1	.	2	.	.
Oligochaeta	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	2	.
Mollusca	.	.	1	.	.	3	.	.	.	.	.	.	.	.	2	.	.
Arachnida	.	.	1	.	2	.	.	.	4	2	2	.	.	.	.	1	.

col = colony

Permanent plots

Permanent plots were set up on the islands. It is hoped that these plots will be visited at intervals to determine if the plant communities are stable or changing. Plots are presently marked with temporary markers.

The plot on Motu I. is 20 x 2 m, and is aligned northwest-southeast (Fig. 1). The species composition is given in Table 5. The plot on Ngawhiti I. consists of two 20 x 2 m sections placed at right angles to each other (Fig. 1). This plot is larger than that on Motu I. because of the greater

TABLE 5. SPECIES COMPOSITION OF PERMANENT PLOT SET UP ON MOTU I. 18 NOVEMBER 1967
(Plot size 20 x 2 m)

m	FLOOR (% cover)	SEEDLINGS (No.)	SAPLINGS (No.)	TREES (No.)	VINES (No.)
0					
	Asplenium lucidum 70	*Hedycarya arborea* 4		*Hedycarya arborea* 1 (50 mm)	*Rhipogonum scandens* 23
	Rhopalostylis sapida 2				
	Litter 28			*Macropiper excelsum* 1	
2					
	Asplenium lucidum 20	*Hedycarya arborea* 17		*Myrsine australis* 1 (100 mm)	*Rhipogonum scandens* 25
	Litter 80	*Macropiper excelsum* 1			
		Rhopalostylis sapida 1		*Macropiper excelsum* 1 (50 mm)	
4					
	Blechnum spp. 10	*Hedycarya arborea* 11	*Neopanax arboreum* 8	*Melicytus ramiflorus* 2	
	Asplenium lucidum 10	*Macropiper excelsum* 4		(40 mm)	
	Litter 80			(90 mm)	
6					
	Blechnum spp. 10	*Hedycarya arborea* 3	*Neopanax arboreum* 8	*Melicytus ramiflorus* 2	
	Litter 90	*Macropiper excelsum* 4		(80 mm)	
				(180 mm)	
8					
	Blechnum spp. 20	*Hedycarya arborea* 7	*Hedycarya arborea* 1	*Griselinia littoralis* 1 (290 mm)	*Rhipogonum scandens* 7
	Litter 80	*Macropiper excelsum* 2			
		Griselinia littoralis 1			
10					
	Large rock	*Griselinia littoralis* 1	*Hedycarya arborea* 1	*Melicytus ramiflorus* 1	*Rhipogonum scandens* 5
	Blechnum spp. 40	*Macropiper excelsum* 2	*Neopanax arboreum* 2	(80 mm)	
	Uncinia sp. 5				
	Asplenium lucidum 2				
	Rhopalostylis sapida 11				
12					
	Blechnum spp. 50	*Griselinia littoralis* 1	*Neopanax arboreum* 1	*Myrsine australis* 1	*Rhipogonum scandens* 6
	Uncinia sp. 30	*Rhopalostylis sapida* 1	*Pittosporum tenuifolium* 1	(60 mm)	
	Litter 20				
14					
	Blechnum spp. 90			*Myrsine australis* 3	*Rhipogonum scandens* 5
	Asplenium lucidum 5			(100 mm)	
	Litter 5			(80 mm)	
				(50 mm)	
16					
	Blechnum spp. 80	*Griselinia littoralis* 1		*Myrsine australis* 3	*Rhipogonum scandens* 10
	Asplenium lucidum 10			(50 mm)	
	Litter 10			(120 mm)	
				(60 mm)	
18	*Blechnum* spp. 70		*Macropiper excelsum* 1	*Myrsine australis* 2	*Rhipogonum scandens* 8
	Asplenium lucidum 30		*Griselinia littoralis* 1	(40 mm)	
				(80 mm)	
20					

m = metres from southwest end.
Figures in parentheses in "Trees" column refer to diameters at breast-height.

TABLE 6. SPECIES COMPOSITION OF PERMANENT PLOT SET UP ON NGAWHITI ISLAND 17 NOVEMBER 1967 (2 sections, each 20 x 2 m) Figures represent the approximate percentage ground cover for each species.

m				
0				
	Coprosma robusta	20	*Pteridium esculentum*	50
	Arrhenatherum elatius	15	*Calystegia* sp.	10
	Dactylis glomerata	5		
2				
	Vicia tetraspermum	10	*Lycium ferocissimum*	3
	Pteridium esculentum	20	*Calystegia* sp.	15
	Arrhenatherum elatius	60	*Dactylis glomerata*	5
4				
	Pteridium esculentum	10	*Calystegia* sp.	15
	Vicia tetraspermum	5	*Arrhenatherum elatius*	50
	Dactylis glomerata	10		
6				
	Pteridium esculentum	20	*Calystegia* sp.	25
	Arrhenatherum elatius	20	*Dactylis glomerata*	35
	Vicia tetraspermum	2		
8				
	Pteridium esculentum	25	*Calystegia* sp.	15
	Arrhenatherum elatius	60	*Dactylis glomerata*	5
	Trifolium campestre	10		
10				
	Pteridium esculentum	30	*Arrhenatherum elatius*	40
	Calystegia sp.	15	*Acaena novaezelandiae*	5
	Vicia tetraspermum	1		
12				
	Pteridium esculentum	70	*Calystegia* sp.	10
	Arrhenatherum elatius	15	*Acaena novaezelandiae*	1
14				
	Pteridium esculentum	60	*Calystegia* sp.	10
	Arrhenatherum elatius	30	*Dactylis glomerata*	2
16				
	Pteridium esculentum	70	*Calystegia* sp.	10
	Rubus sp.	1	*Arrhenatherum elatius*	8
	Dactylis glomerata	5	*Vicia tetraspermum*	2
18				
	Pteridium esculentum	60	*Rubus* sp.	20
	Calystegia sp.	5	*Arrhenatherum elatius*	5
	Vicia tetraspermum	2		
20				

m = metres from east end.

m				
0				
	Phormium cookianum	10	*Pteridium esculentum*	25
	Hebe sp.	1	*Geranium dissectum*	5
	Poa anceps	30	*Anthoxanthum odoratum*	20
	Vicia tetraspermum	10	*Trifolium campestre*	3
2				
	Brassica sp.	2	*Lycium ferocissimum*	3
	Coprosma robusta(*)	35	*Pteridium esculentum*	10
	Blechnum sp.	1	*Juncus* sp.	10
	Arrhenatherum elatius	25	*Vicia tetraspermum*	7
	Poa anceps	20		
4				
	Coprosma robusta (*)	60	*Phormium cookianum*	25
	Pteridium esculentum	10	*Juncus* sp.	5
	Scotch thistle	1	*Dactylis glomerata*	2
	Arrhenatherum elatius	50		
6				
	Pteridium esculentum	5	*Phormium cookianum*	10
	Coprosma robusta	10	*Juncus* sp.	5
	Dactylis glomerata	5	*Arrhenatherum elatius*	60
8				
	Phormium cookianum	50	*Calystegia* sp.	2
	Trifolium repens	1	*Juncus* sp.	5
	Pteridium esculentum	15	*Dactylis glomerata*	5
	Arrhenatherum elatius	45		
10				
	Coprosma robusta (*)	95	*Phormium cookianum*	40
	Pteridium esculentum	20	*Calystegia* sp.	5
	Juncus sp.	5	*Dactylis glomerata*	10
	Arrhenatherum elatius	10		
12				
	Coprosma robusta (*)	90	*Phormium cookianum*	20
	Pteridium esculentum	25	*Blechnum* sp.	15
	Juncus sp.	10	*Calystegia* sp.	10
	Dactylis glomerata	5	*Arrhenatherum elatius*	20
14				
	Pteridium esculentum(*)	75	*Coprosma robusta* (*)	20
	Phormium cookianum	10	*Lycium ferocissimum*	2
	Dactylis glomerata	10	*Calystegia* sp.	60
	Arrhenatherum elatius	25		
16				
	Pteridium esculentum(*)	80	*Coprosma robusta* (*)	10
	Calystegia sp.	25	*Dactylis glomerata*	5
	Arrhenatherum elatius	15		
18				
	Coprosma robusta (*)	15	*Pteridium esculentum*(*)	90
	Calystegia sp.	10	*Phormium cookianum*	5
	Haloragis erecta	2		
20				

m = metres from north end
(*) = Canopy trees or cover overtopping the rest of the vegetation.

vegetational diversity. The species composition is given in Table 6.

Flora of the study areas

A species list of plants found is presented in Table 7. Relative abundances are based on physiognomic dominances of individuals.

Motu I.

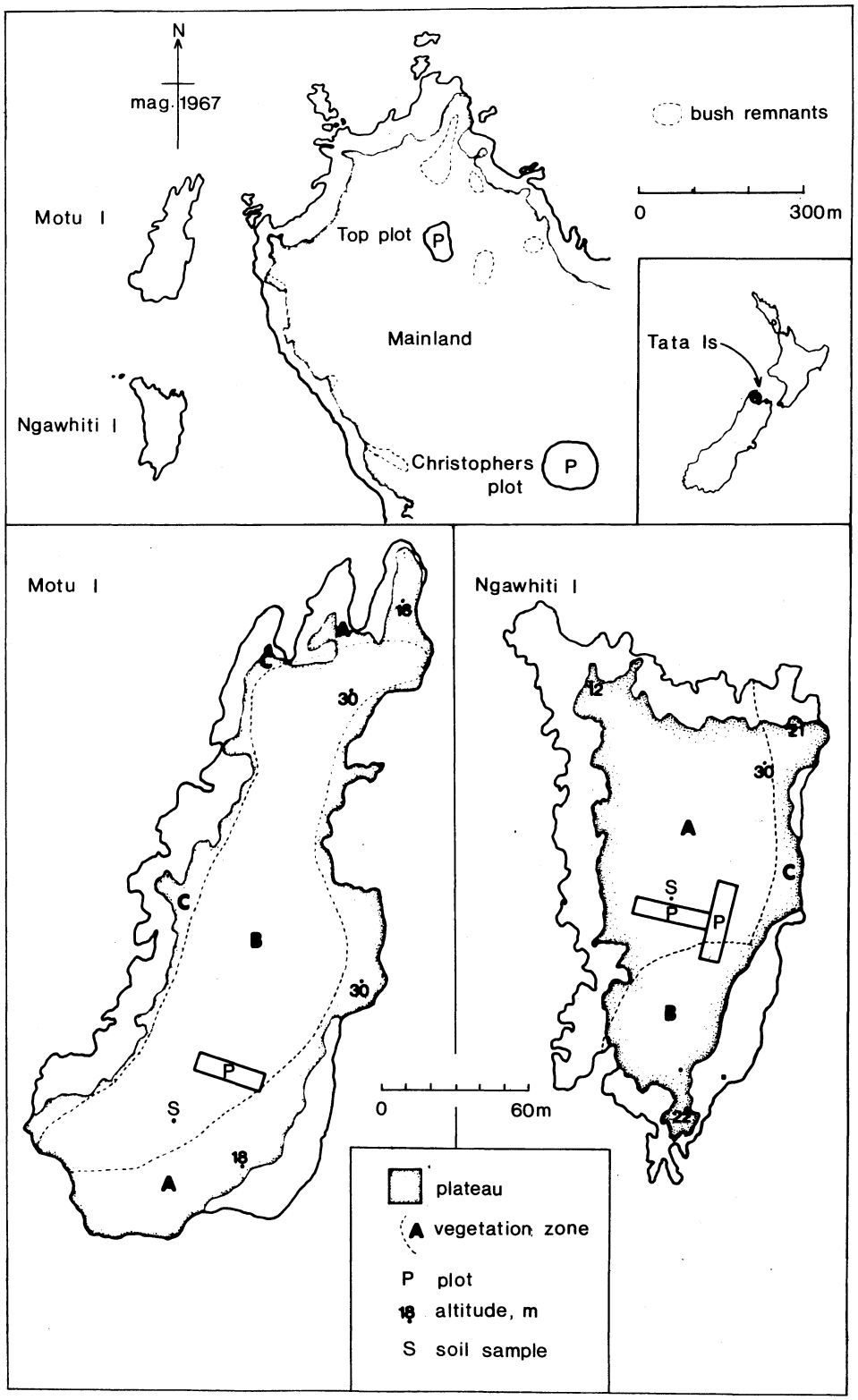
1. Canopy (over 4.6 m high). *Alectryon excelsus, Brachyglottis repanda, Coprosma australis, Corynocarpus laevigatus, Dodonaea viscosa, Hedycarya arborea, Leptospermum scoparium, Macropiper excelsum, Melicope ternata, Melicytus ramiflorus, Myoporum laetum, Pseudopanax arboreum, Paratrophis banksii, Pittosporum tenuifolium, Rhopalostylis sapida.*
2. Tall shrubs (1.2 - 4.6 m). *Brachyglottis repanda, Coprosma repens, C. robusta, Coriaria arborea, Dodonaea viscosa, Hedycarya arborea, Macropiper excelsum, Myoporum laetum, Rhopalostylis sapida.*
3. Small shrubs, epiphytes, ferns (under 1.2 m high). *Arthropodium cirratum, Asplenium bulbiferum, A. flaccidum, A. lucidum, Astelia* sp., *Blechnum filiforme, Clematis paniculata, Linum trigynum, Metrosideros diffusa, M. perforata, Parsonsia heterophylla, Phormium cookianum, Phymatodes diversifolium, Rubus* sp.

Division of Motu I. into regions (Fig. 1)

Region A. This area is moist and sheltered from the prevailing winds. The main canopy species were *Pseudopanax arboreum, Corynocarpus laevigatus, Brachyglottis repanda, Alectryon excelsus,* and a few tree ferns. Other characteristic species were *Coriaria arborea, Leptospermum scoparium,* and *Coprosma robusta.* Canopy level was about 9 m, this being nearly as high as the highest canopy level found in parts of the mainland remnant bush. The undergrowth was dense, with a thick growth of *Asplenium lucidum.* Other ferns were quite abundant, as were seedlings of canopy species. *Rhipogonum scandens* lianes formed a dense network between trees and shrubs. Epiphytes and climbers were more numerous here than in any other part of the island. On the sheltered cliff tops and sides there was a dense growth of flowering *Arthropodium cirratum.*

Region B. The plateau is mainly flat. A dense regeneration of nikau palms (*Rhopalostylis sapida*) was present in one area. Undergrowth was dense and variable in composition, however, *Asplenium lucidum* was considered the physiognomic dominant. *Rhipogonum scandens* was common. Characteristic canopy species were *Melicytus ramiflorus, Pittosporum tenuifolium,* and *Hedycarya arborea.* Seedlings of these species, as well as *Rhopalostylis sapida* and *Alectryon excelsus,* were abundant.

Region C. The canopy is constantly subjected to sea spray carried by west and southwest winds, and dead twigs and shoots are a feature of the plants of the region. The height of the canopy was only 1.8 - 2.4 m in places, and the maximum height was 6 m. Characteristic plants were *Coprosma repens, Myoporum laetum* and stunted *Melicytus ramiflorus*. There were few lianes. Undergrowth was not nearly as dense as on other parts of the island.


N
mag. 1967
bush remnants
0
300m
Motu I
Top plot
P
Mainland
Ngawhiti I
Christophers
plot
P
Tata Is
Motu I
Ngawhiti I
A
B
C
P
S
18
30
12
21
24
0
60m
plateau
A vegetation zone
P plot
18 altitude, m
S soil sample

Ngawhiti I.

The vegetation structure is similar to that described by Esler (1962) as introduced scrublands of bracken fern type.

1. Canopy (over 4.6 m high). Absent.
2. Tall shrubs (1.2 - 4.6 m). *Brachyglottis repanda, Coprosma robusta, Corynocarpus laevigatus, Pseudopanax arboreum.*
3. Small shrubs, ferns, herbs (under 1.2 m high). *Acaena novaezelandiae, Arthropodium cirratum, Calystegia* sp., *Coprosma robusta, Hebe salicifolia, Linum trigynum, Phormium cookianum, Phymatodes diversifolium, Polystichum richardii, Pteridium esculentum, Rubus* sp.
4. Seedlings. *Coprosma robusta, Hebe salicifolia, Hedycarya arborea, Melicytus ramiflorus, Myrsine australis, Phormium cookianum.*

Division of Ngawhiti I. into regions (Fig. 1)

Region A. This is an almost flat plateau gently sloping to the west. Characteristic vegetation was *Pteridium esculentum,* patches of *Coprosma robusta, Phormium cookianum,* and introduced grasses. There were restricted patches of gorse (*Ulex europaeus*) and blackberry (*Rubus* sp.).

Region B. This area is more protected from wind than region A. *Hebe* and *Coprosma* plants were dominant, and provided good protection for growth of broadleaf seedlings such as *Melicytus ramiflorus* and *Hedycarya arborea.*

Region C. This region escaped much of the effects of the 1954 fire. The presence of old and well-formed trees has resulted in small areas of plants whose composition and structure are similar to those on corresponding positions on Motu I.

Top plot (Fig. 1)

1. Canopy (over 4.6 m high). *Alectryon excelsus, Carpodetus serratus, Fuchsia excorticata, Hedycarya arborea, Macropiper excelsum, Melicytus ramiflorus, Pennantia corymbosa, Rhopalostylis sapida.*
2. Tall shrubs (1.2 - 4.6 m). *Macropiper excelsum, Olearia rani, Paratrophis microphylla, Pennantia corymbosa.*
3. Small shrubs, epiphytes, ferns (under 1.2 m high). *Asplenium bulbiferum, A. flaccidum, A. lucidum, Astelia* sp., *Coprosma australis, C. rhamnoides, Meterosideros diffusa, M. perforata, Olearia rani, Paratrophis microphylla, Parsonsia heterophylla, Rhipogonum scandens, Rubus* sp.
4. Seedlings. *Hedycarya arborea, Macropiper excelsum, Melicytus ramiflorus, Rhopalostylis sapida, Rhipogonum scandens.*

This scrub was situated in a north-facing shallow gully. Surrounding hills protected it from prevailing winds. It was about 54 m wide at its greatest diameter, and not divisible into separate floristic regions.

Christopher's plot (Fig. 1)

1. Canopy (over 4.6 m high). *Alectryon excelsus, Coprosma australis, Entelea arborescens, Fuchsia excorticata, Hedycarya arborea, Melicytus ramiflorus, Olearia rani.*
2. Tall shrubs (1.2 - 4.6 m). *Cyathea dealbata, Hedycarya arborea, Macropiper excelsum, Melicytus ramiflorus, Rhopalostylis sapida, Schefflera digitata.*

TABLE 7. FLORA OF THE FOUR STUDY AREAS.
A = abundant, C = common, O = occasional, R = rare, NR = present, but abundance not recorded.
* = new record for Abel Tasman National Park, i = introduced species, v = voucher specimen held by the Biological Society, University of Canterbury.

	Species	Study Area			
		Ngawhiti I	Motu I	Top plot	Christophers plot
	FERNS				
v	*Adiantum cunninghamii* Hooker	O	O	R	
v	*Asplenium bulbiferum* Forster f.		C	C	O
v	*Asplenium falcatum* Lamarck		NR		
	Asplenium flaccidum Forster f.		C	C	O
v	*Asplenium lucidum* Forster f.	C	A	O	
	Blechnum capense (Linnaeus) von Schlechtendal	O			
v	*Blechnum filiforme* Cunningham		C	C	O
v	*Cyathea dealbata* (Forster f.) Swartz		R	O	O
	Hypolepis sp.	R	O	A	C
v	**Lastreopsis glabella* (Cunningham) Tindale			NR	
v	*Pellaea rotundifolia* (Forster f.) Hooker		O		C
v	*Phymatodes diversifolium* (Willdenow) Pichi-Sermolli	O	O		R
v	*Phymatodes scandens* (Forster f.) Presl			O	R
v	*Polystichum richardii* (Hooker) Smith	R	NR		
v	*Pteridium aquilinum esculentum* (Forster f.) Kuhn	A			
v	*Pteris macilenta* Richard	NR		NR	
	Pyrrosia serpens (Forster f.) Ching		O	C	
v	*Thelypteris pennigera* (Forster f.) Allan			NR	
	MONOCOTYLEDONS				
v	*Arthropodium cirratum* (Forster f.) Brown	A	A		
	Astelia sp.		O	O	O
v	*Phormium cookianum* Le Jolis	A	C		
v	*Rhopalostylis sapida* Wendland et Drude		O	R	R
v	*Rhipogonum scandens* J.R. et G. Forster		A	A	A
v	*Uncinia* sp.		C	O	O
i v	**Bromus sterilis* Linnaeus	O			
i v	*Anthoxanthum odoratum* Linnaeus	C			
v	*Poa anceps*	C			
i v	*Dactylis glomerata* Linnaeus	C			
i v	**Arrhenatherum elatius* (Linnaeus) Mert et Koch	C			
i v	*Holcus lanatus* Linnaeus	C			
i v	*Microlaena polynoda*	C			
v	*Dianella nigra* Colenso	O			
	DICOTYLEDONS				
	Acaena novae-zelandiae Kirk	C			
v	*Alectryon excelsus* Gaertner		O	O	O

TABLE 7 (continued)

	Species	Study Area			
		Ngawhiti I	Motu I	Top plot	Christophers plot
v	*Apium australe* Thouars		NR		
i v	*Berberis glaucocarpa*	O			
	Brachyglottis repanda J.R. et G. Forster	R	A		
i v	*Brassica* sp.	NR			
	Calystegia tuguriorum	A			
	Carpodetus serratus J.R. et G. Forster			R	
v	*Clematis paniculata* Gmelin		R		
v	*Coprosma australis* (Richard) Robinson		O	O	R
	Coprosma repens Richard	O	C		
	Coprosma rhamnoides Cunningham			O	R
v	*Coprosma robusta* Raoul	A	C		R
v	*Coriaria arborea* Lindsay		R		
	Corynocarpus laevigatus J.R. et G. Forster	R	C		
v	*Disphyma australe* (Solander) Black	NR			
	Dodonaea viscosa Jacquin	R	C		
	Entelea arborescens Brown				R
i v	*Erigeron floribunda*	NR			
	Fuchsia excorticata (J.R. et G. Forster) Linnaeus			O	O
v	*Geranium solandri*	C			
	Griselinia littoralis Raoul		C		
	Griselinia lucida Forster f.		C		
v	*Haloragis erecta* (Banks ex Murray) Eichler	NR			
v	*Hebe parviflora* (Vahl) Cockayne et Allan		C		
v	*Hebe salicifolia* (Forster f.) Pennell	A	R		
v	*Hedycarya arborea* J.R. et G. Forster		A	C	C
	Leptospermum scoparium J.R. et G. Forster		R	R	
v	*Linum trigynum*	A	O		
v	*Macropiper excelsum* (Forster f.) Miguel	R	A	C	C
	Melicope ternata J.R. et G. Forster		R		
v	*Melicytus ramiflorus* J.R. et G. Forster	O	A	A	O
	Metrosideros diffusa (Forster f.) Smith		O	O	O
v	*Metrosideros perforata* (J.R. et G. Forster) Richard		C	C	C
	Myoporum laetum Forster f.	R	O		
v	*Myrsine australis* (Richard) Allan	R	O		
v	*Pseudopanax arboreum* (Murray) Allan	R	O		
v	*Olearia arborescens* (Forster f.) Cockayne et Laing		NR		
	Olearia rani (Cunningham) Druce			C	C
i v	**Orobanche minor*		R		

TABLE 7 (continued)

		Species	Study Area			
			Ngawhiti I	Motu I	Top plot	Christophers plot
		Paratrophis banksii Cheeseman		R		
		**Paratrophis microphylla* (Raoul) Cockayne			O	
		**Parsonsia capsularis* (Forster f.) Brown				R
		Parsonsia heterophylla Cunningham		C	C	O
	v	*Pennantia corymbosa* J.R. et G. Forster		R	C	
	v	*Peperomia urvilleana* Richard		NR		
	v	**Pittosporum colensoi* Hooker		NR		
		Pittosporum tenuifolium Solander ex Gaertner	R	O		
	v	*Plantago lanceolata*	O			
		Rubus sp.	O	R	C	R
		Schlefflera digitata J.R. et G. Forster				R
	v	*Senecio lautus lautus* Solander ex Willdenow		NR		
	v	**Sonchus* sp.		NR		
	v	*Sonchus* sp.	O			
i	v	*Trifolium pratense*	NR			
i	v	*Trifolium campestre* Von Schreber	A			
i	v	*Ulex europaeus* Linnaeus	C			
i	v	*Vicia tetrasperma* (Linnaeus) Moench	A			

3. Small shrubs, epiphytes, ferns (under 1.2 m high). *Adiantum cunninghami, Asplenium bulbiferum, Astelia* sp., *Coprosma rhamnoides, Metrosideros diffusa, M.perforata, Olearia rani, Parsonsia* sp., *Pellaea rotundifolia, Rhipogonum scandens, Uncinia* sp.
4. Seedlings. Most canopy and tall shrub species were present.

This plot was in a sheltered west-facing valley. The canopy was up to 15 m high, but the understory was very open. Species diversity was low compared with the other study areas.

DISCUSSION

Of the four study areas, the vegetation of Christopher's plot showed most evidence of having been modified by introduced animals. Sheep and possums were present here, and records indicate that until very recently cattle used the bush for shelter. As a result, the understory was open with evidence of trampling and browsing. The ground was bare except for a few clumps of *Uncinia* sp. and occasional ferns.

The understory of Top plot was generally open, with small shrubs and a few seedlings. It appeared as if sheep were the main cause in opening up the understory.

As far as could be ascertained, no mammals have lived on Motu I. However, the activities of penguins have restricted the undergrowth in many places on the west side of the island.

Ngawhiti I. has been most affected by man's activities. Species such as *Pteridium aquilinum esculentum, Phormium cookianum, Coprosma robusta,* and a number of introduced species, are plants typical of a fire-induced succession. Successional changes can be further studied in years to come using the permanent plots.

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